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Relativistic Heavy Ion Collider
Magnet Division Procedure

Proc. No.: RHIC-MAG-R-7226

Issue Date: May 22, 1989

Rev. No.: E

Rev. Date: April 2, 1993

Class: Dipole Coils

Title: RHIC Dipole/Quadrupole Coil Length Measurement

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- Q. A. Approval: Signature on File
- ES&H Review: Signature on File

REVISION RECORD

Rev. No.	Date	Page	Subject	Approval	QA	ES&H
A	2/13/91	1,2,6	General revisions. Removed section			
			3.2.2 completely. Replaced data			
			sheet with new one. Added additional			
			coil length measurements	On File		
B	11/22/91	2,6,	Addition of quadrupole magnet to	On File		
		7,8,9	Procedure. Revised data sheet, page 6.	On File		
C	5/27/92	9	Removed Fig. 2. Eliminated quad	On File		
			coil length measurements after			
			shell welding.	On File		
D	8/11/92	2,3	Reference change per SCR #414.	On File		
E	4/2/93		Specification changes per SCR #479.	On File	On File	On File

1. Scope:

This procedure describes the method used to measure the longitudinal length of an individual coil and the collared coil/yoke assembly. The overall accuracy of this measurement is to be within 0.010 inches.

2. Applicable Documents:

2.1 Drawings

BNL Dwg. 25-802.07-2A	Coil Holder
BNL Dwg. 25-802.01-5A	Collaring Holder
BNL Dwg. 25-802.06-3	Rod (Invar) (typical, 10 ft. length)
BNL Dwg. 25-802.02-2	Indicator End Piece
BNL Dwg. 25-802.13-2	Square

3. Requirements:

3.1 Tooling:

- 3.1.1 The tooling required is listed above.
- 3.1.2 Thermometer capable of reading $\pm 0.1^{\circ}\text{C}$.
- 3.1.3 Vernier caliper with measuring accuracy ± 0.001 inches.
(0-12 in. range)
- 3.1.4 Depth micrometer with measuring accuracy of ± 0.001 inches.
(0-6 in. range)

3.2 Procedure:

3.2.1 Overall length measurement:

- 3.2.1.1 If measuring the length of an individual coil, mount the coil holders above the stands used to position the coil in an inner diameter-upward position on a bench. (See Fig. 1.) If measuring a collared coil, mount the collaring holders around the collared coil/yoke assembly.
- 3.2.1.2 Using a steel tape, make a rough measurement of the total length of the coil or collared coil. The measurement is to be made in inches with a tolerance of $\pm 1/4$ in. The purpose is to aid in the selection of Invar rods.

- 3.2.1.3 Select appropriate lengths of Invar rods to be used, based on the length measurement described in step 3.2.1.2. The total length of the assembled Invar rods should be longer than the length of the saddle coil by 12 inches or less.
- 3.2.1.4 Mount the Invar rod sections onto the slot in the coil or collaring holder. Mating surfaces of rods must be cleaned and free of burrs, nicks, etc. Screw the rod sections together so they butt to one another.
- 3.2.1.5 Mount the end pieces and squares on the two ends of the assembled Invar rods and adjust the position of the square so the attached depth micrometer will contact the coil or collared coil along its centerline, and midway between its inner diameter and outer diameter (See Fig. 1.).
- 3.2.1.6 Record the length dimensions of:
- (1) Lead end end piece.
 - (2) Non-lead end end piece.
 - (3) Invar rods.
- On Work Sheet A, lines 1, 2, and 3, respectively
- 3.2.1.7 Calculate the sum of the length dimensions of lead end end piece, non-lead end end piece and invar rods on Work Sheet A, line 4.
- 3.2.1.8 Using the attached depth micrometer, measure the distances from each end piece to the aforementioned points on the coil or collared coil to the nearest 0.001 inches. (See Fig. 1.). Record on Work Sheet A, lines 5 and 6.
- 3.2.1.9 Calculate the sum of the depth micrometer distances and record on Work Sheet A, line 7.
- 3.2.1.10 Subtract the sum of the depth micrometer distances from the sum of the indicator end pieces and the Invar rod lengths to find the overall length (A). Record on Worksheet A, line 8. Record measurement on the attached data sheets, A and B for dipole coils, A and C for quadrupole coils. Measure and record coil temperature on data sheets.
- 3.2.1.11 Carefully disassemble the measurement apparatus and place it in its storage case for future use.
- 3.3 Coil End Measurements - The following procedures determine the length of the coil straight section (D), and the distance between the last coil turn and the end of the coil straight section, (G) and (H).

3.3.1 Insert the appropriate Pole Spacer Inspection Tool at the coil end being measured:

Pole Spacer Inspection Tool Identification	BNL Drawing Number
RHIC Dipole (9B84) Lead End	25-00.440-4
RHIC Dipole (9B84) Non-Lead End	25-00.441-4
RHIC Quadrupole (A6) Lead End	25-1152.01-3
RHIC Quadrupole (A6) Non Lead End	25-1152.02-3
RHIC Quadrupole (QRI) Lead End	25-1224.01-3A
RHIC Quadrupole (QRI) Non-Lead End	25-1224.02-3A

3.3.2 Perform the measurement between the flat surfaces of the Pole Spacer Inspection Tool and End Saddle (B) using a vernier caliper. Record the measurement on Data Sheet A.

3.3.3 Repeat measurement for other end of the coil (C) and record it on the Data Sheet A.

3.3.4 Remove the Pole Spacer Inspection Tools and store for future use.

3.3.5 Complete Data Sheet A as outlined on data sheet.

4. Quality Assurance Provisions:

The Quality Assurance Provisions of this procedure require compliance with the procedural instructions contained herein.

4.1 Calibration - The following tools must have a current calibration:

Vernier caliper
Depth micrometer
Invar rods

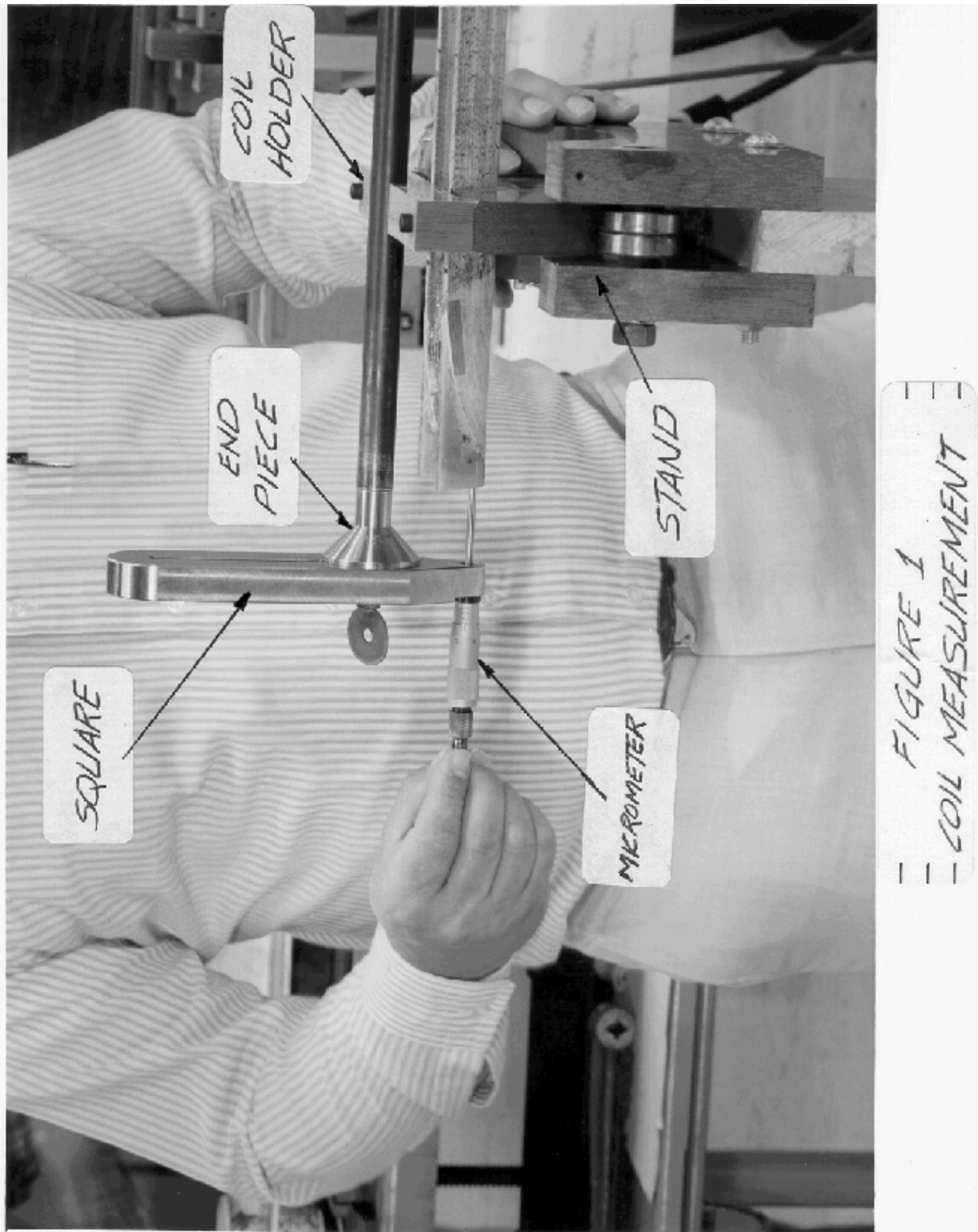
5. Preparation for Delivery:

N/A

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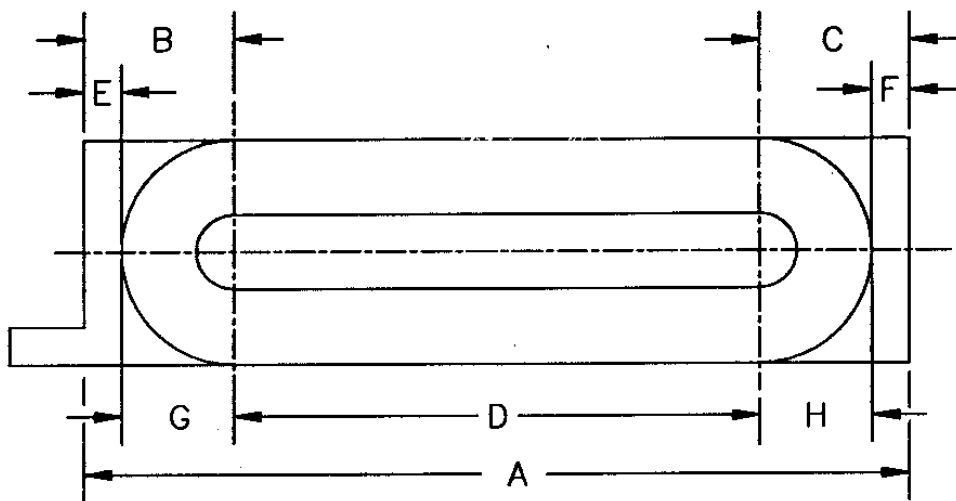
DATA SHEET A RHIC Dipole/Quadrupole Coil Length Measurement

Serial No. _____

Check One ☐ Dipole
☐ Quadrupole

INDIVIDUAL COIL

Coil: _____



All measurements are to be made with end saddles attached.

Coil Temperature: _____ °C
 Overall Length(A): _____ inches
 Lead End Length(B): _____ inches (not including splicing turn)
 Non-Lead End Length(C): _____ inches
 Straight Section Length(D) = $A - [B + C]$ _____ in.
 *Saddle Thickness (At Outer Radius) @ Lead End(E) = _____ in.
 *Saddle Thickness (At Outer Radius) @ Non-Lead End(F) = _____ in.
 Last Turn Location @ Lead End(G) = $B - E$ = _____ in.
 Last Turn Location @ Non-Lead End(H) = $C - F$ = _____ in.
 *Dimensions obtained from applicable Saddle drawings.

Lead Saddle Attached YES NO
 [] []

Non-Lead Saddle Attached [] []

Above Work Done By: _____

Comments: _____

Name & Life No., Date _____

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DATA SHEET B
Dipole Coils Overall Length Measurements

PRE-COLLARING

	Coil No.	Overall Measured Length (in.)	Coil Temp.
Upper			_____ °C
Lower			

Comments: _____

Above work done by: _____

Name & Life No., Date

POST-COLLARING

	Coil No.	Overall Measured Length (in.)	Coil Temp.
Upper			_____ °C
Lower			

Comments: _____

Above work done by: _____

Name & Life No., Date

SHELL WELDED

	Coil No.	Overall Measured Length (in.)	Coil Temp.
Upper			_____ °C
Lower			

Comments: _____

Above work done by: _____

Name & Life No., Date

DATA SHEET C

Quadrupole Coils - Overall Length Measurements

*Coil Location	Coil Number
Upper Left	
Upper Right	
Lower Left	
Lower Right	

*NOTE: All locations given are as viewed from lead end of coil.

Event	Overall Coil Length (in.)				
	Upper		Lower		Coil Temp (⁰ C)
	Left	Right	Left	Right	
Pre-Collaring					

Comments: _____

Above work done by: _____

Name & Life No., Date

Event	Overall Coil Length (in.)				
	Upper		Lower		Coil Temp (⁰ C)
	Left	Right	Left	Right	
Post-Collaring					

Comments: _____

Above work done by: _____

Name & Life No., Date

Coil Overall Length Measurement
Worksheet A

1)	Lead end end piece length		_____
2)	Non-lead end end piece length		_____
3)	Invar rod lengths	1.	_____
		2.	_____
		3.	_____
		4.	_____
		5.	_____
		6.	_____
4)	Total sum	=	_____
5)	Depth micrometer length, lead end	=	_____
6)	Depth micrometer length, non-lead end	=	_____
7)	Sum (depth micrometer lengths)	=	_____
8)	Overall coil length (subtract (7) - (4) insert this number into Data Sheets A, B and/or C for overall length.	=	_____